PATENT SPECIFICATION (11) 1 438 610

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(21) Application No. 29753/74 (22) Filed 4 Jul. 1974
(31) Convention Application No. 9866/73 (32) Filed 6 Jul. 1973 in
(33) Switzerland (CH)
(44) Complete Specification Published 9 Jun. 1976
(51) INT. CL.[2] H01B 9/02 H01F 27/32
(52) Index at Acceptance H1A 2E3D3 3M H1T 15 1F 7C3

(19)

(54) ELECTRICALLY CONDUCTING PART WITH INSULATION

(71) We, BBC BROWN BOVERI & COMPANY LIMITED, of Baden, Switzerland, a Swiss Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The present invention relates to insulated electrical conductors.

During or after the insulation of electrical conductors by encapsulating with casting resin, the resin frequently becomes detached from such parts due to shrinkage arising from the chemical reactions in the resin, at least in specific places, or the insulation cracks. In the case of parts which carry high voltage, potential differences between conductor and insulation at such places frequently lead to tracking or a glow discharge and thus to the destruction of the resin insulating material.

Shrinking or cracking of the insulation due to different thermal expansion of the insulation and conductor is also possible in addition to detachment of the insulation due to the reaction shrinkage described above. These effects frequently lead to failure of the insulation.

According to the invention we provide an electrical conductor having thereon insulation composed of a casting resin, and a resilient electrically conducting or semiconducting foam interposed between the conductor and insulation and bonded to the latter, the foam comprising an epoxy resin, a polyurethane resin, a urea-formaldehyde resin or a phenol-formaldehyde resin and having cells whose walls have a mechanical strength sufficient to withstand evacuation.

The foam enables expansion or shrinkage due to thermal or reaction effects, and the previously described detrimental consequences, to be rendered harmless in mechanical as well as in electrical terms. The foam can be applied quickly, simply and cheaply.

Partially open cell foam or closed cell foam may be used; the foam should be suitable for evacuation, i.e. be mechanically strong so that no gases can escape from the foam in the course of evacuation.

The invention can be applied with particular advantage to resin-encapsulated transformers. the invention can however also be applied to resin-encapsulated apparatus components which carry high voltage and medium voltage and to busbars which are encapsulated in casting resin and are fully insulated.

The foam ensures reliable electric coupling of the insulation to the conductor to eliminate tracking or discharge, but the mechanical coupling is non-rigid so that cracking of insulation is eliminated. Furthermore, it permits a saving of casting resin, because it is only necessary to provide enough casting resin to withstand the appropriate voltage. Furthermore, the cost of the foam is low because it requires only inexpensive raw materials and simple technological processes.

One embodiment of the invention is described hereinbelow and is illustrated in the accompanying drawing in which:—

Figure 1 is a longitudinal section through a known insulated conductor;

Figures 2*a* and 2*b* are figures which illustrate the invention; and

Figure 3 is a sketch explaining the electrical coupling and mechanical decoupling achieved by the invention.

Figure 1 is a longitudinal section of an electrical conductor 1 with an insulating casting resin layer 2. The casting resin layer 2 has become detached in places from the electrical conductor 1 following thermal shrinkage or chemical reaction shrinkage of the casting resin, forming voids or cracks 4 which lead to tracking.

Figures 2*a* and 2*b* show an electrical conductor 1 with an insulating casting resin layer 2 and an intervening layer of electrically semiconducting or conducting resilient foam 3. The casting resin 2 is mechanically decoupled

from, i.e. not rigidly connected to, the electrical conductor 1 by the resilient foam 3, which compensates for the traction, shrinkage and thermal stresses between the parts 1 and 2. This kind of mechanical decoupling of the insulation 2 reliably avoids any formation of cracks therein.

Figure 3 shows a longitudinal section of part of an electrical conductor corresponding to those of Figures 2*a* and 2*b*, voids or cracks 4 and 4' being visible. Electrical coupling of the casting resin layer 2 to the electrical conductor 1 is ensured by the electrically semiconducting or conducting nature of the resilient foam 3, so that no potential differences which may give rise to tracking can occur between the conductor 1 and the foam 3 which surrounds the crack or void 4. If a crack 4' occurs at the inner surface of insulation 2, a layer of the semiconducting or conducting foam 3 will adhere to the casting resin 2 thus preventing the appearance of any electrically detrimental potential difference.

WHAT WE CLAIM IS:—

1. An electrical conductor having thereon insulation composed of a casting resin, and a resilient electrically conducting or semi-conducting foam interposed between the conductor and insulation and bonded to the latter, the foam comprising an epoxy resin, a polyurethane resin, a urea-formaldehyde resin or a phenol-formaldehyde resin and having cells whose walls have a mechanical strength sufficient to withstand evacuation.

2. An insulated conductor as claimed in Claim 1, in which the foam has closed or partly open cells.

MARKS & CLERK

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1976.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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1 SHEET

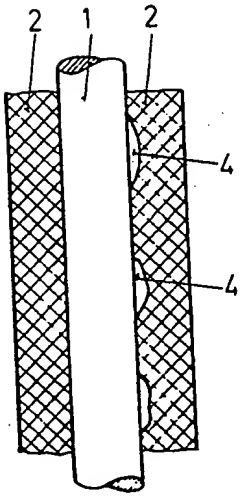

FIG.1

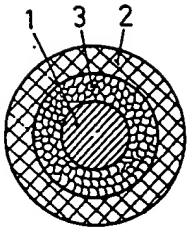

FIG.2a

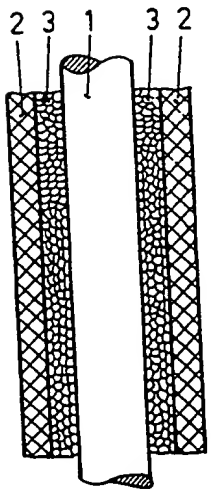

FIG.2b

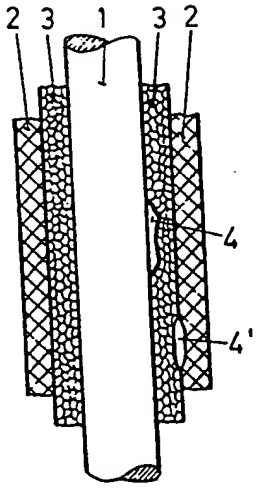

FIG.3